

Mars Global Surveyor Ka-band Link Experiment Results

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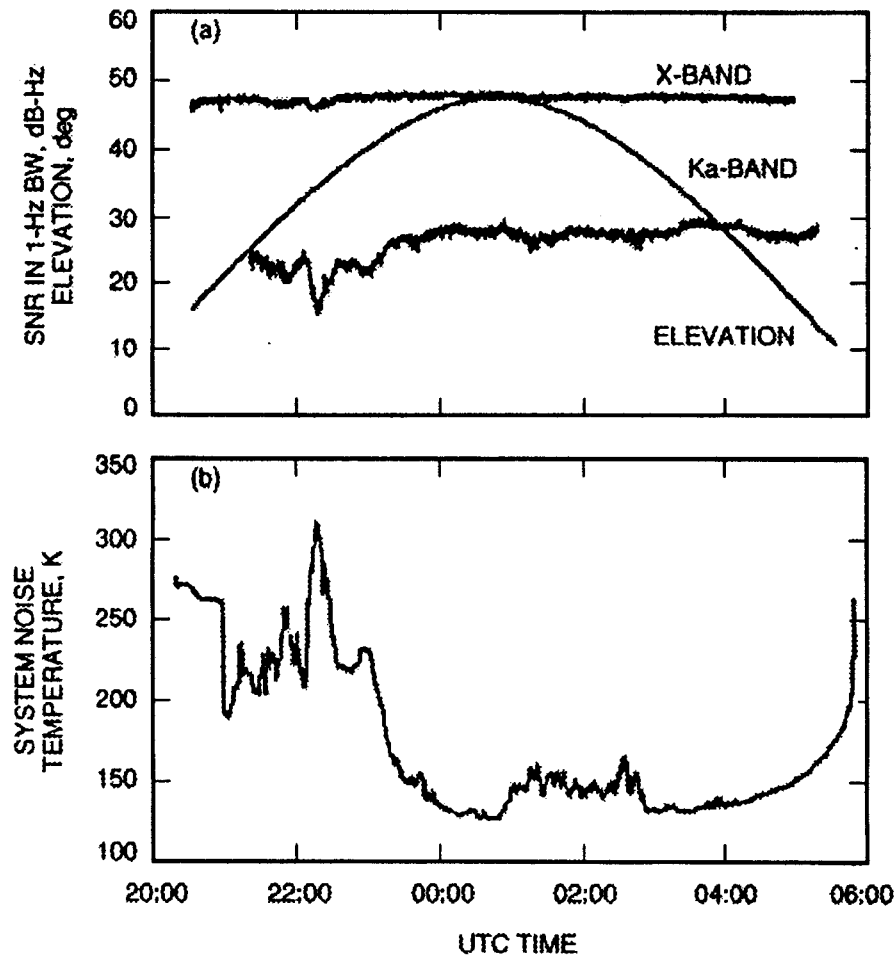
Deep Space Ka-band Link Advantage

- Ka-band (32 GHz) has a 11.6 dB theoretical advantage over X-band (8.4 GHz) as a telecommunications link frequency
- This advantage is reduced to 6 to 8 dB in practice due to increased atmospheric and amplifier noise at Ka-band and DSN antenna imperfections which are less significant at X-band
- This link advantage results in spacecraft mass and power savings or higher data rates
- An analysis of two years of Mars Global Surveyor simultaneous Ka-band and X-band data demonstrated this link advantage using a 34-m beam waveguide (BWG) antenna

Deep Space Ka-band Telecommunications

- As link frequency increases, antenna pointing becomes a greater concern
- The use of a 34-m BWG antenna allows feed equipment to be located in subterranean pedestal room “isolated” from outside environmental effects (condensation)
- Signals for Deep Space links will be weaker than those of earth orbiting satellites and mitigation options are more limited

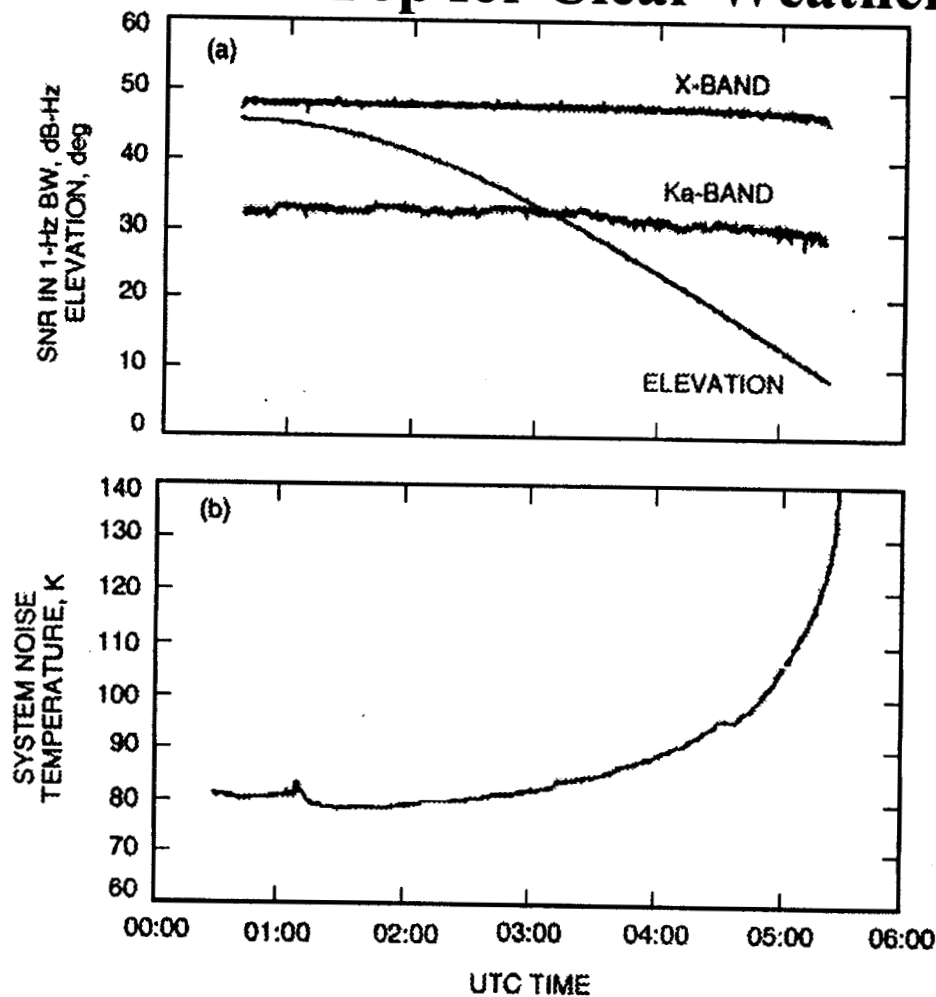
MGS Ka-band and X-band Pc/No Signal Levels and Ka-band Top for Rainy Weather Pass



Ref. Morabito, Butman and Shambayati,
"The Mars Global Surveyor Ka-band Link
Experiment", Published in JPL TMO
Progress Report 42-137, May 15, 1999
http://tmo.jpl.nasa.gov/tmo/progress_report

Pass 97-203 (a) X-band and Ka-band Pc/No and elevation angle and
(b) Ka-band Top.

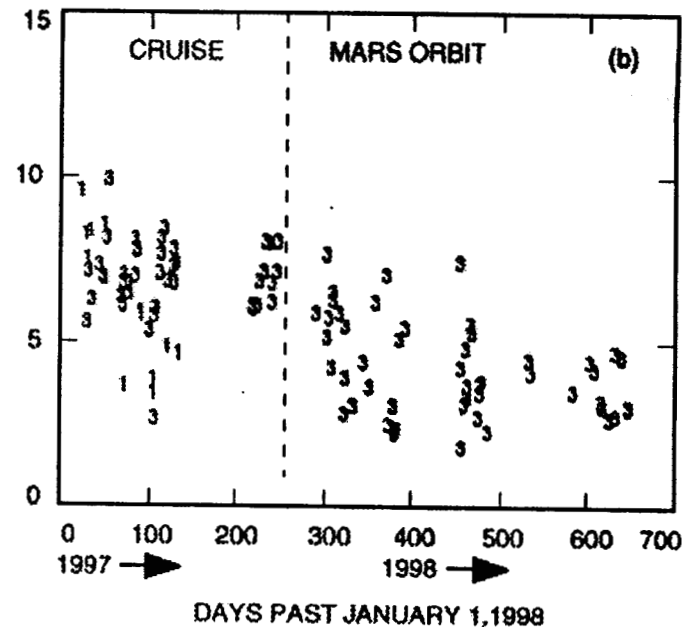
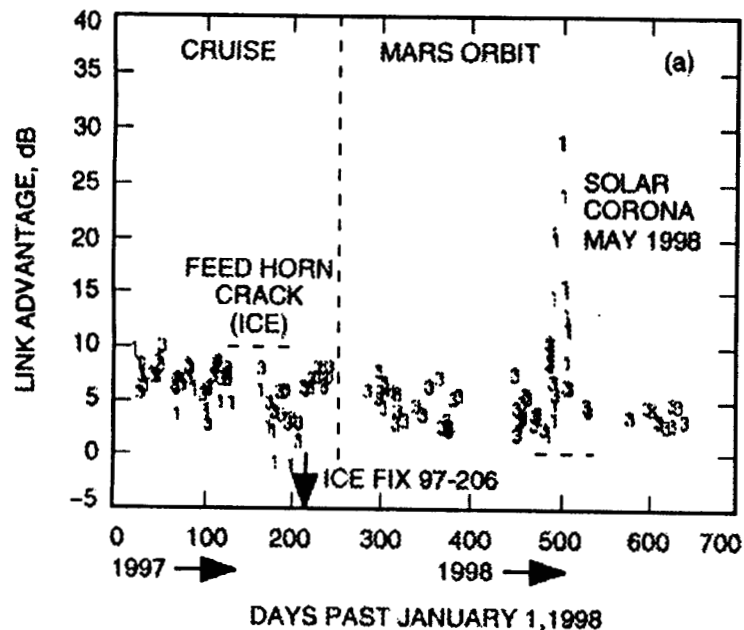
MGS Ka-band and X-band Pc/No Signal Levels and Ka-band Top for Clear Weather Pass



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Pass 97-212 (a) X-band and Ka-band Pc/No and elevation angle and
(b) Ka-band Top.

MGS Ka-band to X-band Link Advantage Corrected for Known Telecom Equipment Deficiencies



Ka-band link advantage versus day of year, corrected for known equipment deficiencies, for (a) all data and (b) all data except solar corona and the cracked feed horn period with scale expanded. Note that majority of passes during cruise period, link advantage falls between 6 to 8 dB.

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Conclusion

- A 6 to 8 dB link advantage can be realized by using Ka-band (32 GHz) as a telecommunications link frequency in place of X-band (8.4 GHz)
- This link advantage was demonstrated using two years of Mars Global Surveyor simultaneous Ka/X data after correcting for known equipment deficiencies